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TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

Attorney's Docket No. 2576-119

U.S. Application No. (If known, see 37 CFR 1.5) 09/936293 Not Yet Assigned

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP00/00102	January 12, 2000	

TITLE OF INVENTION
MOBILE COMMUNICATION TERMINAL

APPLICANT(S) FOR DO/EO/US
Yuji KAKEHI

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [ ] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [ ] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [X] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US)
6. [X] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [X] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been transmitted by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has **NOT** expired.
   d. [X] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

ITEMS 11. TO 16. below concern other document(s) or information included:

11. [X] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [ ] A **FIRST** preliminary amendment.
    [ ] A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [X] Other items or information: Courtesy copy of International Application PCT/JP00/00102 w/attached International Search Report in Japanese and English; 12 sheets of drawings; 6 cited references, Form PCT/IB/301 and Form PCT/IB/308.

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY DOCKET NO.
Not Yet Assigned 09/936293	PCT/JP00/00102	2576-119

17. [X] The following fees are submitted:		CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492)(a)(1)-(5):			
Search Report has been prepared by the EPO or JPO	$ 860.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482)	$ 690.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))	$ 710.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO	$ 1,000.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)	$ 100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =		$ 860.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		$	

Claims	Number Filed	Number Extra	Rate		
Total Claims	15 -20 =	0	X $18.00	$	
Independent Claims	3 - 3 =	0	X $80.00	$	
Multiple dependent claim(s) (if applicable)			+ $270.00	$	
TOTAL OF ABOVE CALCULATIONS =				$ 860.00	
Reduction by 1/2 for filing by small entity, if applicable. Applicant(s) hereby claim small entity.				$	
SUBTOTAL =				$ 860.00	
Processing fee of $130.00 for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$ 860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				$	
TOTAL FEES ENCLOSED =				$ 860.00	
				Amount to be refunded	$
				charged	$

a. [X] Two checks totaling $860.00 to cover the above fees are enclosed.

b. [ ] Please charge my Deposit Account No. 02-2135 in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-2135. A duplicate copy of this sheet is enclosed.

d. [ ] Payment by credit card. (Form PTO-2038 enclosed.)

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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Registration Number

SPECIFICATION

Mobile Communication Terminal

Technical Field

The present invention relates to a mobile communication terminal employing a code division multiplex method for communication, and particularly a mobile communication terminal which tracks a path of the maximum receiving level.

Background Art

In recent years, mobile communication terminals such as a portable telephone and a mobile telephone have been widely used, and various kinds of multiple access methods have been developed for use in such mobile communication systems. Among them, a CDMA (Code Division Multiple Access) method has been employed in portable telephones and others because it has high quality reception capability through the exploitation of multipath fading, and can achieve a high utilization efficiency of radio resource (can increase a subscriber capacity). A state of communication to a base station may be impaired due to, e.g., movement of a mobile station such as a portable telephone employing the CDMA system. In this case, so-called hand-over, which is the operation of switching to the communication channel of another base station, is performed for maintaining a better communication state.

Fig. 13 shows occurrence of the hand-over. In general, a plurality of base stations (BS1 - BS5) are arranged regularly, and cells of the base stations form a regular polygon if these base stations are arranged to cover a service area with as high a electric field as possible, as is well known and shown in Fig. 13. When a mobile communication terminal (MS) performs the communication, it receives a plurality of radio waves from each base station. When the mobile communication terminal moves through a boundary between cells or sectors, and particularly when fading occurs, the path at the maximum level frequently changes so that the hand-over is

frequently performed.

For the mobile communication terminal, such a method is generally known that changes the timing for sampling clock for performing timing tracking. According to the timing control for the sampling clock by a digital circuit, however, the accuracy of the change becomes low. In the case where the foregoing hand-over is frequently performed, therefore, the quality of data receiving operation deteriorates.

The invention has been developed for overcoming the above problem, and a first object of the invention is to provide a mobile communication terminal, which can prevent lowering of a receiving quality due to frequent switching of a most significant cell/sector.

A second object of the invention is to provide a mobile communication terminal, which can prevent lowering of a receiving quality due to frequent switching of a primary path.

A third object of the invention is to provide a mobile communication terminal, which can produce sampling clocks of different timing by a simple structure.

Disclosure of the Invention

According to one aspect of the present invention, a mobile communication terminal is equipped with a receiver to receive a radio waves from a base station; a sampling unit to sample the signals received by the receiver; a demodulating unit to demodulate the signals sampled by the sampling unit; a selector to select the most significant cell/sector based on the data demodulated by the demodulator; a path detector to detect the primary path based on the data sampled by the sampling unit; and a clock generator to generate a sampling clock with changed timing by inserting different frequency clocks into sampling clocks based on the primary path detected by the path detector, and supply the produced sampling clock to the sampling unit.

The clock generator generates sampling clocks with changed timing by inserting different frequency clocks into sampling clocks, the sampling timing of the sampling unit can be changed easily.

Preferably, the clock generator inserts a single clock with a different frequency to change sampling clock timing.

Since only one clock with a different frequency is inserted by the clock generator, the sampling timings can be changed even more easily.

More preferably, the mobile communication terminal is a mobile communication terminal adopts a CDMA system.

According to another embodiment of the invention, a mobile communication terminal is equipped with a receiver to receive radio waves from a base station; a sampling unit to sample the signals received by the receiver; a demodulator to demodulate the signals sampled by the sampling unit; a selector to select the most significant cell/sector based on the data demodulated by the demodulator; a path detector to detect a multiple of paths based on the signals sampled by the sampling unit; a determining unit to detect the primary path among several paths detected by the path detector, and determine whether the primary path should be changed or not, based on the forward or backward protection states of the primary path; and a clock generator to generate sampling clocks with changed timing based on the primary path determination by the determining unit, and supply the sampling clocks to the sampling unit.

The determining unit detects the primary path among the several paths detected by the path detector, and determines whether the primary path should be changed or not, based on the forward or backward protection states of the primary path. This procedure can prevent the degradation in receiving quality due to frequent transition of the primary path.

Preferably, the determining unit determines whether the primary path should be changed or not, by shifting the states between the first state in which no primary path is present, the second state in which the primary path is in backward protection, the third state in which the primary path is fixed, and the fourth state in which the primary path is in forward protection.

The determining unit selects the primary path by shifting the states between the above four states, which makes possible to change the primary

path properly.

More preferably, when the primary path is detected, the determining unit shifts the states from the first state to the second state, and determines that the primary path should be changed.

The determining unit changes the primary path only when the states shifts from the first state to the second state, which makes it possible to prevent degradation in the receiving quality due to frequent transition of the primary path.

More preferably, the determining unit shifts the states from the second state to the third state when the primary path is continuously detected for a specified number of times.

The determining unit shifts the states from the second state to the third state when the primary path is continuously detected for a specified number of times, which makes it possible to prevent degradation in the receiving quality due to frequent transition of the primary path.

More preferably, the determining unit shifts the states from the fourth state to the first state when the primary path is not continuously detected for a specified number of times.

The determining unit shifts the states from the fourth state to the first state only when the primary path is not continuously detected for a specified number of times, which makes it possible to prevent degradation in the receiving quality due to frequent transition of the primary path.

More preferably, the clock generator generates the sampling clock with changed timing based on the determination by the determining unit upon every passage of a specified time.

The clock generator changes the timing of the sampling clock only when a specified time elapses, which makes it possible to prevent degradation in the receiving quality due to frequent transition of the primary path.

More preferably, the mobile communication terminal adopts a CDMA system.

By applying the invention to the CDMA-based mobile communication terminal path tracking can be properly performed.

According to still another aspect of the invention, a mobile communication terminal is equipped with a receiver to receive radio waves from a base station; a sampling unit to sample the signals received by the receiver; a demodulator to demodulate the signals sampled by the sampling unit; a selector to select the most significant cell/sector based on the data demodulated by the demodulator, using at least two different thresholds; and a path detector to detect a primary path based on the signals sampled by the sampling unit.

The selector uses at least two different thresholds to select the most significant cell/sector based on the data demodulated by the demodulator, which makes it possible to prevent degradation in the receiving quality due to frequent transition of the most significant cell/sector.

Preferably, the selector selects the sector with the maximum receiving level as the new most significant cell/sector when the receiving level of the current most significant cell/sector is lower than the first threshold, and the above maximum receiving level of the sector is equal to or higher than the second threshold which is higher than the first threshold.

The selector changes the most significant cell/sector only when the receiving level of the most significant cell/sector is lower than the first threshold, and the maximum receiving level of the sectors is equal to or higher than the second threshold which is higher than the first threshold. This procedure can prevent degradation in the receiving quality due to frequent transition of the most significant cell/sector.

Preferably, the selector selects the sector with the maximum quality of channels/channel quality as the new most significant cell/sector when the quality of channels/channel quality of the current most significant cell/sector remains lower than the first threshold for the period specified by the second threshold or longer.

The selector changes the most significant cell/sector only when the quality of channels/channel quality of the current most significant cell/sector is lower than the first threshold for the second threshold period or longer. This procedure can prevent degradation in receiving quality

due to frequent transition of the most significant cell/sector.

Preferably, the selector selects the sector of the maximum quality of channels/channel quality as the new most significant cell/sector when the quality of channels/channel quality difference between the sector with maximum quality of channels/channel quality and the current most significant cell/sector exceeds the first threshold for the period specified by the second threshold or longer.

The selector selects the sector with the maximum quality of channels/channel quality as the new most significant cell/sector when the quality of channels/channel quality difference between the sector with maximum quality of channels/channel quality and the current most significant cell/sector exceeds the first threshold for the period specified by the second threshold or longer. This procedure can prevent degradation in the receiving quality due to frequent transition of the most significant cell/sector.

More preferably, the mobile communication terminal adopts CDMA system.

By applying the invention to the CDMA-based mobile communication terminal path tracking can be properly performed.

Brief Description of the Drawings

Fig. 1 shows a block diagram of a general structure of a mobile communication terminal in the first embodiment of the invention;

Figs. 2A - 2C show a concept of change in sampling clock timings;

Fig. 3 shows a general structure of a clock generator 7;

Fig. 4 shows a process flowchart for a mobile communication terminal in the first embodiment of the invention;

Fig. 5 shows primary path selection procedures;

Fig. 6 shows a process flowchart of most significant cell/sector selection preformed by a mobile communication terminal in the second embodiment of the invention;

Figs. 7A and 7B show receiving levels in the case of reselecting the most significant cell/sector;

Fig. 8 shows a process flowchart of most significant cell/sector selection performed by a mobile communication terminal in the third embodiment of the invention;

Figs. 9A and 9B show line qualities in the case reselecting the most significant cell/sector;

Fig. 10 shows a process flowchart of most significant cell/sector selection performed by a mobile communication terminal in the fourth embodiment of the invention;

Figs. 11A and 11B show quality of channels/channel quality differences in the case of reselecting the most significant cell/sector;

Fig. 12 shows a process flowchart of clock control performed by a mobile communication terminal in the fifth embodiment of the invention; and

Fig. 13 shows occurrence of a handover.

Best Mode for Carrying Out the Invention

More details of the invention are described in the following with reference to the accompanying diagrams.

(First Embodiment)

Fig. 1 shows the general structure of a mobile communication terminal in the first embodiment of the present invention. This mobile communication terminal is equipped with antenna 1, receiver 2 which receives weak radio waves sent from a base station via antenna 1, A/D (Analog/Digital) converter 3 which converts received analog signals into digital signals for output, control unit 4 which performs overall control of the mobile communication terminal, a demodulator 5 which demodulates the received signals sent from A/D converter 3, path detector 6 which detects a tracking path (primary path), and clock generator 7 which generates a sampling clock with changed timing. Control unit 4 controls clock generator 7 in accordance with the primary path detected by path detector 6, and changes the timing of the sampling clock. A/D converter 3 samples the received signals using the sampling clocks generated from clock generator 7.

Figs. 2A - 2C show a conceptual diagram of timing change in a sampling clock. Fig. 2A shows a normal sampling clock with a constant period which is supplied to A/D converter 3. When control unit 4 determines that the timing of the sampling clock is delayed relative to the frame, only a single short-pulse clock is inserted into the last sampling clock of the frame, as shown in Fig. 2B, to advance the timing of the sampling clock. When control unit 4 determines that the timing of the sampling clock is advanced relative to the frame, only a single long-pulse clock is inserted into the last sampling clock of the frame, as shown in Fig. 2C, to delay the timing of the sampling clock.

Fig. 3 shows the general structure of clock generator 7. Clock generator 7 includes switch 71, 1/3 frequency divider circuit 72 which divides an original clock frequency to output a clock frequency reduced to 1/3, 1/4 frequency divider circuit 73 which divides the original clock frequency to output a clock frequency reduced to 1/4, 1/5 frequency divider circuit 74 which divides an original clock frequency to output a clock frequency reduced to 1/5, and OR circuit 75. The dividing ratios of divider circuits 72 - 74 are set to 1/3 - 1/5 to simplify description, but these ratios are not conditional.

To generate a normal sampling clock timing as shown in Fig. 2A, switch 71 is operated to supply the original clock into 1/4 divider circuit 73.

To advance the sampling clock timing as shown in Fig. 2B, switch 71 is operated to supply the original clock into 1/3 divided circuit 72. If 1/3 divider circuit 72 outputs only one clock, switch 71 is switched backed to supply the original clock into 1/4 divider circuit 73.

To delay the timing of the sampling clock as shown in Fig. 2C, switch 71 is switched to supply the original clock into 1/5 divider circuit 74. If 1/5 divider circuit 74 outputs only one clock, switch 71 is switched backed to supply the original clock into 1/4 divider circuit 73.

Fig. 4 shows a process flowchart of the mobile communication terminal of this embodiment. At first, control unit 4 selects the most significant cell/sector (S1). The cell is usually divided into a multiple sector zones, and handover control between the sectors is performed. As

in a conventional implementation the sector of the highest receiving level is selected as the most significant cell/sector. Control unit 4 follows to select the primary path (S2).

Fig. 5 shows the selection procedure of the primary path. In state 1, no primary path is present. This state is achieved at the start of communication or change of the primary path. In states 2, 3 and 4 the primary path is in backward protection fixed and forward protection states, respectively.

Usually, a signal to identify frame boundaries is added to a part of received data so that the timing of the mobile communication terminal may be correctly adjusted relative to the frame alignment of the received signal. This control signal synchronizes the mobile communication terminal and the received signal.

For example, when the primary path is not present (state 1), the path of the most significant receiving level is selected as the primary path, and the current state changes to state 2. If the primary path is continuously detected for Nr times when the primary path is in the backward alignment (state 2), the current state changes to state 3. If the primary path is not detected, the current state changes to state 1. If the primary path is not detected when the primary path is fixed (state 3), the current state changes to state 4. If the primary path is detected when the primary path is in forward protection (state 4), the current state changes to state 3. If the primary path is not continuously detected for Nf times, the current state changes to state 1. After the primary path is fixed in this manner, the primary path remains unchanged unless the primary path is continuously detected for Nf times. This procedure can prevent frequent change of the primary path.

Descriptions on Fig. 4 continue. The primary path is changed in step S3, and if the new primary path is advanced relative to the last primary path (S3, ①), control unit 4 controls clock generator 7 to advance the clock as shown in Fig. 2B (S4). When the primary path remains the same (S3, ②), the procedure ends. When the primary path is changed, and the changed primary path is delayed relative to the last primary path

(S3, ③), control unit 4 controls clock generator 7 to delay the clock as shown in Fig. 2C (S5).

As described above, the mobile communication terminal in this embodiment performs primary path selection by detecting forward protection or backward protection state of the primary path, and the primary path is changed only when the primary path is in the forward alignment state, and the primary path is not continuously detected for Nf times. This procedure can prevent degradation in the receiving quality due to short cycle transition of the primary path.

According to the controlling method of the sampling clock, only a single clock with different frequency is inserted to control the sampling clock timing, which makes clock control easy to perform. Therefore, the clock can be controlled easily.

(Second Embodiment)

A mobile communication terminal in the second embodiment of the present invention differs from that in the first embodiment in Fig. 1 only in respect to the procedure of the control unit. The procedure of a mobile communication terminal in the second embodiment differs from that of a mobile communication terminal in the first embodiment in Fig. 4 only in respect to the selecting procedure of the most significant cell/sector in step S1. Accordingly, descriptions of the common structures and functions are not repeated. In the description of this embodiment, a reference number "4a" indicates the control unit, and step S1a substitutes for step S1.

Fig. 6 shows process flowchart for more details on the most significant cell/sector selection (S1a) of the mobile communication terminal in this embodiment. Thresholds 1 and 2 represent different receiving levels, respectively, and threshold 1 is lower than threshold 2.

At first, control unit 4a acquires the receiving level of the most significant cell/sector from demodulator 5 (S1), to determine whether the acquired receiving level is lower than threshold 1 or not (S12). If the receiving level of the most significant cell/sector is equal to or higher than threshold 1 (No in S12), control unit 4a ends the procedure. If the receiving level of the most significant cell/sector is lower than threshold 1

(Yes in S12), control unit 4a acquires the highest receiving level among those of the sectors from demodulator 5, to determine whether the receiving level is equal to or higher than threshold 2 or not (S13).

If the highest receiving level of the sector is lower than threshold 2 (No in S13), control unit 4a ends the procedure. If the highest receiving level of the sector is equal to or higher than threshold 2 (Yes in S13), control unit 4a selects the sector of the highest receiving level as the new most significant cell/sector (S14), and ends the procedure.

Figs. 7A and 7B show the receiving levels in the case of changing the most significant cell/sector. As shown in Fig. 7A, if the receiving level of the most significant cell/sector (cell/sector 1) is equal to or higher than threshold 1, the most significant cell/sector remains the same. When the receiving level of the most significant cell/sector (cell/sector 1) becomes lower than threshold 1 as in Fig. 7B, cell/sector 2 is selected as the new most significant cell/sector since the largest receiving level of the cell/sector 2 is equal to or higher than threshold 2. In Fig. 7B, if both the receiving levels of cell/sector 2 and cell/sector 3 are lower than threshold 2, and also lower than the receiving level of cell/sector 1 cell/sector 1 remains as the most significant cell/sector.

As already described, the mobile communication terminal in this embodiment changes the primary path only when the receiving level of the most significant cell/sector is lower than threshold 1, and the highest receiving level of the sector is equal to or higher than threshold 2. This procedure can prevent degradation in the receiving quality due to short cycle transition of the most significant cell/sector.

(Third Embodiment)

A mobile communication terminal of the third embodiment of the present invention differs from that in the first embodiment shown in Fig. 1 only in respect to the procedure of the control unit. The procedure of the mobile communication terminal in the third embodiment differs from that of the mobile communication terminal in the first embodiment in Fig. 4 only in respect to the selecting procedure of the most significant cell/sector in step S1. Accordingly, descriptions of the common structures and

functions are repeated. In this embodiment, a reference number "4b" indicates the control unit, and step S1b substitutes for step S1.

Fig. 8 shows a process flowchart for the more detailed description of the most significant cell/sector selection (S1b) of a mobile communication terminal in this embodiment. Threshold 1 represents a quality of channels/channel quality threshold, and threshold 2 represents a counter threshold. The quality of channels/channel quality depends on the number of bit errors which are counted for a specified time period.

At first, control unit 4b detects the quality of channels/channel quality at the most significant cell/sector reception (S21), and determines whether the detected quality of channels/channel quality is lower than threshold 1 or not (S22). If the quality of channels/channel quality of the most significant cell/sector is equal to or higher than threshold 1 (No in S22), control unit 4b sets the counter to "0" (S26), and ends the procedure. If the quality of channels/channel quality of the most significant cell/sector is lower than threshold 1 (Yes in S22), control unit 4b increments the counter (S23), and determines whether the counter value is equal to or higher than threshold 2 or not (S24).

If the counter value is lower than threshold 2 (No in S24), control unit 4b ends the procedure. If the counter value is equal to or higher than threshold 2 (Yes in S24), control unit 4b selects the sector of the best quality of channels/channel quality as the new most significant cell/sector, sets the counter to "0" (S25) and ends the procedure.

Figs. 9A and 9B show line qualities in the case of changing the most significant cell/sector. If the quality of channels/channel quality of most significant cell/sector (cell/sector 1) becomes lower than threshold 1 as in Fig. 9A, the counter is incremented. However, as long as the counter value is lower than threshold 2, the most significant cell/sector remains the same.

If the quality of channels/channel quality of the most significant cell/sector (cell/sector 1) remains lower than threshold 1, and the counter value is incremented to or above threshold 2, cell/sector 2 of the best quality of channels/channel quality is selected to substitute as the most

significant cell/sector as in Fig. 9B. If the quality of channels/channel quality of the most significant cell/sector (cell/sector 1) becomes equal to or higher than threshold 1 before the counter value becomes equal to or higher than threshold 2, the counter is reset to "0", and returns to the initial state.

As described above, a mobile communication terminal in this embodiment selects the sector of the best quality of channels/channel quality as the most significant cell/sector only if the quality of channels/channel quality of the most significant cell/sector remains lower than threshold 1 for a specified time. This procedure can prevent degradation in the receiving quality due to short cycle transition of the most significant cell/sector.

(Fourth Embodiment)

A mobile communication terminal in the fourth embodiment of the invention differs from that of the first embodiment shown in Fig. 1 only in respect to the procedure of the control unit. The procedure of the mobile communication terminal in the fourth embodiment differs from that of the mobile communication terminal in the first embodiment in Fig. 4 only in respect to the selection procedure of the most significant cell/sector in step S1. Accordingly, descriptions of the common structures and functions are not repeated. In this embodiment, a reference number "4c" indicates the control unit, and a step S1c substitutes for step S1.

Fig. 10 shows a process flowchart for more detailed description of the most significant cell/sector selection (S1c) of a mobile communication terminal in this embodiment. Threshold 1 represents a threshold of quality of channels/channel quality difference, and threshold 2 represents a counter threshold. The quality of channels/channel quality difference represents a difference between the highest of the line qualities of cell/sector and the quality of channels/channel quality of the most significant cell/sector.

At first, control unit 4b detects difference in quality of channels/channel quality between the most significant cell/sector and another cell/sector (S31), and determines whether the detected quality of

channels/channel quality difference exceeds threshold 1 or not (S32). If the quality of channels/channel quality difference is equal to or smaller than threshold 1 (No in S32), control unit 4c sets the counter to "0" (S36), and ends the procedure. If the quality of channels/channel quality difference exceeds threshold 1 (Yes in S32), control unit 4c increments the counter (S33), and determines whether the counter value is equal to or larger than threshold 2 or not (S34).

If the counter value is lower than threshold 2 (No in S34), control unit 4c ends the procedure. If the counter value is equal to or higher than threshold 2 (Yes in S34), control unit 4c selects the sector of the best quality of channels/channel quality to substitute the current most significant cell/sector, sets the counter to "0" (S35), and ends the procedure.

Figs. 11A and 11B show quality of channels/channel quality differences in the case of changed most significant cell/sector. When the quality of channels/channel quality of most significant cell/sector (cell/sector 1) deteriorates to the point of increasing the quality of channels/channel quality difference to exceed threshold 1 as shown in Fig. 11A, the counter is incremented. However, if the counter value is lower than threshold 2, the most significant cell/sector remains the same.

If the quality of channels/channel quality difference of the most significant cell/sector (cell/sector 1) continues to exceed threshold 1, and the counter value is incremented to or above threshold 2, cell/sector 2 of the best quality of channels/channel quality is selected as the most significant cell/sector as shown in Fig. 11B. If the quality of channels/channel quality difference becomes equal to or lower than threshold 1 sooner than counter value becomes equal to or higher than threshold 2, the counter is set to "0", and returns to the initial state.

As described above, a mobile communication terminal in this embodiment select the sector of the best quality of channels/channel quality as the most significant cell/sector only if the quality of channels/channel quality difference remains larger than threshold 1 for a specified time. This procedure can prevent degradation in the receiving quality due to short cycle transition of the most significant cell/sector.

(Fifth Embodiment)

A mobile communication terminal in the fifth embodiment of the present invention differs from the mobile communication terminal in the first embodiment in Fig. 1 only in respect to the procedure of the control unit. The procedure of the mobile communication terminal in the fifth embodiment differs from that of the mobile communication terminal in the first embodiment in Fig. 4 only on the point that the clock control procedures in steps S41 - S47 substitute for S3 - S5. Accordingly, descriptions of the common structures and functions are not repeated. In this embodiment, a reference number "4d" indicates the control unit.

Fig. 12 shows a process flowchart of the clock control performed by a mobile communication terminal in this embodiment. At first, control unit 4d decrements the counter value (S41), and determines whether the counter value is equal to or higher than 0 or not (S42). If the counter value is equal to or higher than 0 (Yes in S42), control unit 4d ends the procedure. If the counter value is lower than 0 (No in S42), control unit 4d determines the timing of the primary path (S43).

When the primary path is changed, and the new primary path is advanced relative to the last primary path (① in S43), control unit 4d controls clock generator 7 to advance the clock timing as in Fig. 2B (S44), sets a restricted number of row in the counter the clock timing (S45), and ends the procedure. If the primary path remains unchanged (② in S43), the procedure ends. If the primary path is changed, and the new primary path is delayed relative to the last primary path (③ in S43), control unit 4d controls clock generator 7 to delay the clock timing as in Fig. 2C (S46), sets a restricted number of row of rows in the counter (S47), and ends the procedure.

As described above, a mobile communication terminal of this embodiment sets the restricted number of row of rows in the counter, and the clock control is not performed until the counter value becomes equal to or lower than 0. This procedure can prevent degradation in the receiving quality due to frequent change in the clock timing.

Although the present invention has been described and illustrated

in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.

CLAIMS

1. A mobile communication terminal comprising:

a receiver (2) receiving a radio wave from a base station;

a sampling unit (3) sampling a signal received by said receiver (2);

a demodulator (5) demodulating the signal sampled by said sampling unit (3);

a cell selector (4) selecting a most significant cell/sector based on data demodulated by said demodulator (5);

a path detector (6) detecting multiple paths based on the signal sampled by said sampling unit (3); and

a clock generator (7) generating sampling clocks with changed timing by inserting different frequency clocks into the sampling clock based on the cell/sector selected by said cell selector and based on the primary path detected by said path detector (6), and supplying the sampling clock to said sampling unit (3).

2. The mobile communication terminal according to claim 1, wherein

said clock generator (7) inserts one different frequency clock into the sampling clock to change the timing of said sampling clock.

3. The mobile communication terminal according to claim 1, wherein

said mobile communication terminal is a mobile communication terminal employing a code division multiple access system.

4. A mobile communication terminal comprising:

a receiver (2) receiving a radio wave from a base station;

a sampling unit (3) sampling a signal received by said receiver (2);

a demodulator (5) demodulating the signal sampled by said sampling unit (3);

a cell selector (4) selecting a most significant cell/sector based on

data demodulated by said demodulator (5);

a path detector (6) detecting multiple paths based on the signal sampled by said sampling unit (3);

a determining unit (4) detecting a primary path from the multiple paths detected by said path detector (6), and determining whether said primary path is to be changed or not, based on the states of the forward alignment and backward alignment of said primary path; and

a clock generator (7) generating a sampling clock with changed timing based on a result of the determination by said determining unit (4), and supplying the sampling clock to said sampling unit (3).

5. The mobile communication terminal according to claim 4, wherein

said determining unit (4) determines whether the primary path is to be changed or not, by transference of the state between:

a first state that no primary path is present,

a second state that the primary path is in a state of backward protection,

a third state that the primary path is in a fixed state, and

a fourth state that the primary path is in a state of forward protection.

6. The mobile communication terminal according to claim 5, wherein

said determining unit (4) transfers the state from the first state to the second state, and determines that the primary path is to be changed when the primary path is detected in the first state.

7. The mobile communication terminal according to claim 5, wherein

said determining unit (4) transfers the state from said second state to said third state when the primary path is continuously detected multiple times.

8. The mobile communication terminal according to claim 5, wherein

said determining unit (4) transfers the state from said fourth state to said first state when the primary path is not continuously detected multiple times.

9. The mobile communication terminal according to claim 4, wherein

said clock generator (7) generates the sampling clock with changed timing based on the primary path determined by said determining unit (4) at regular intervals.

10. The mobile communication terminal according to claim 4, wherein

said mobile communication terminal is a mobile communication terminal employing a code division multiple access system.

11. A mobile communication terminal comprising:

a receiver (2) receiving a radio wave from a base station;

a sampling unit (3) sampling a signal received by said receiver (2);

a cell selector (4) selecting a most significant cell/sector based on signal sampled by said sampling unit (3), using at least two different threshold; and

a path detector (6) detecting multiple paths based on the signal sampled by said sampling unit (3).

12. The mobile communication terminal according to claim 11, wherein

said selecting unit (4) selects a sector/cell of the maximum receiving level as a new most significant cell/sector when a receiving level of the current most significant cell/sector is smaller than a first threshold, and said maximum receiving level of the sector/cell is equal to or higher than a

second threshold which is higher than said first threshold.

13. The mobile communication terminal according to claim 11, wherein

said selecting unit (4) selects the cell/sector of the maximum quality of channels as a new most significant cell/sector when a quality of channels of the current most significant cell/sector is worser than a first threshold for a period of a second threshold or more.

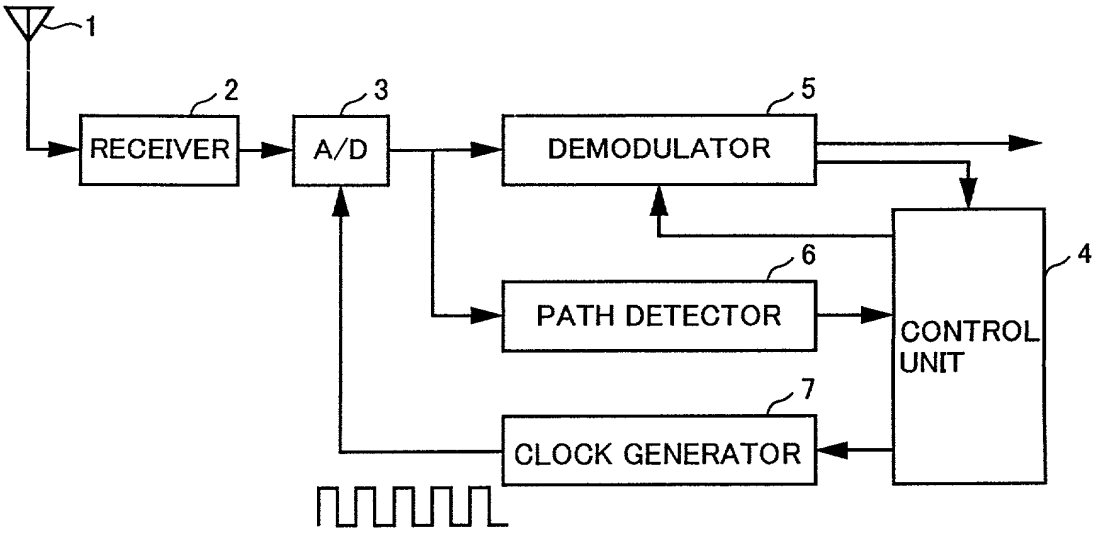
14. The mobile communication terminal according to claim 11, wherein

said selecting unit (4) selects the cell/sector of the maximum quality of channels as a new most significant cell/sector when a difference between the maximum quality of channels of the sectors and the quality of channels of the current most significant cell/sector is higher than a first threshold for a period of a second threshold or more.

15. The mobile communication terminal according to claim 11, wherein

said mobile communication terminal is a mobile communication terminal employing a code division multiple access system.

FIG. 1



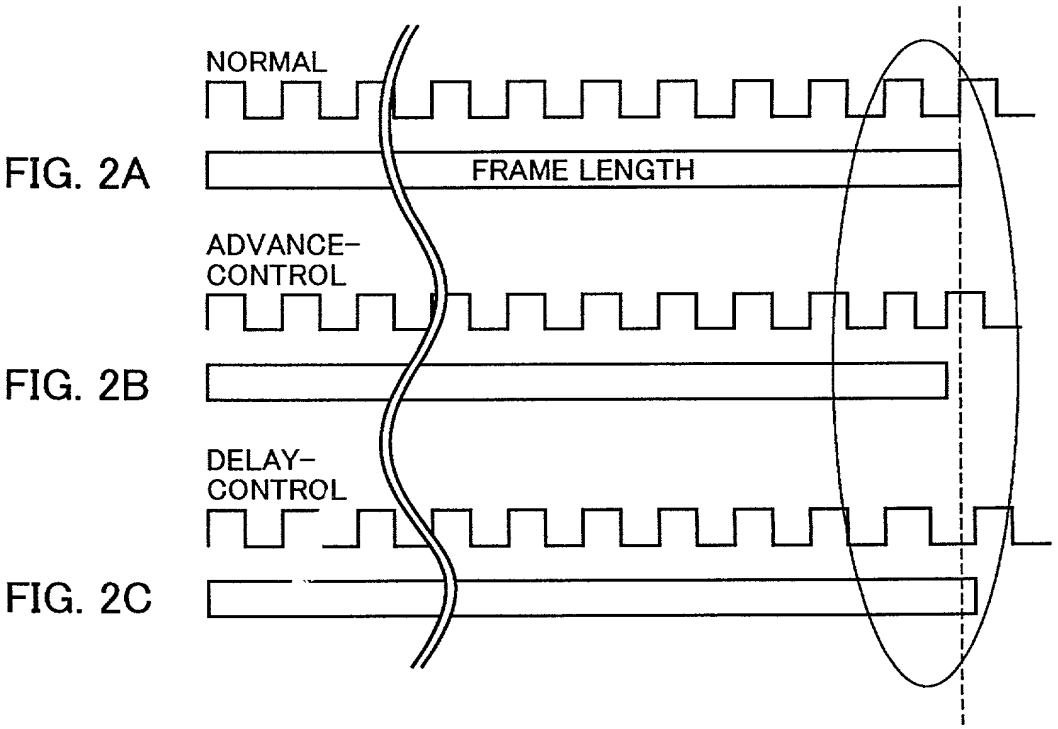


FIG. 2A

FIG. 2B

FIG. 2C

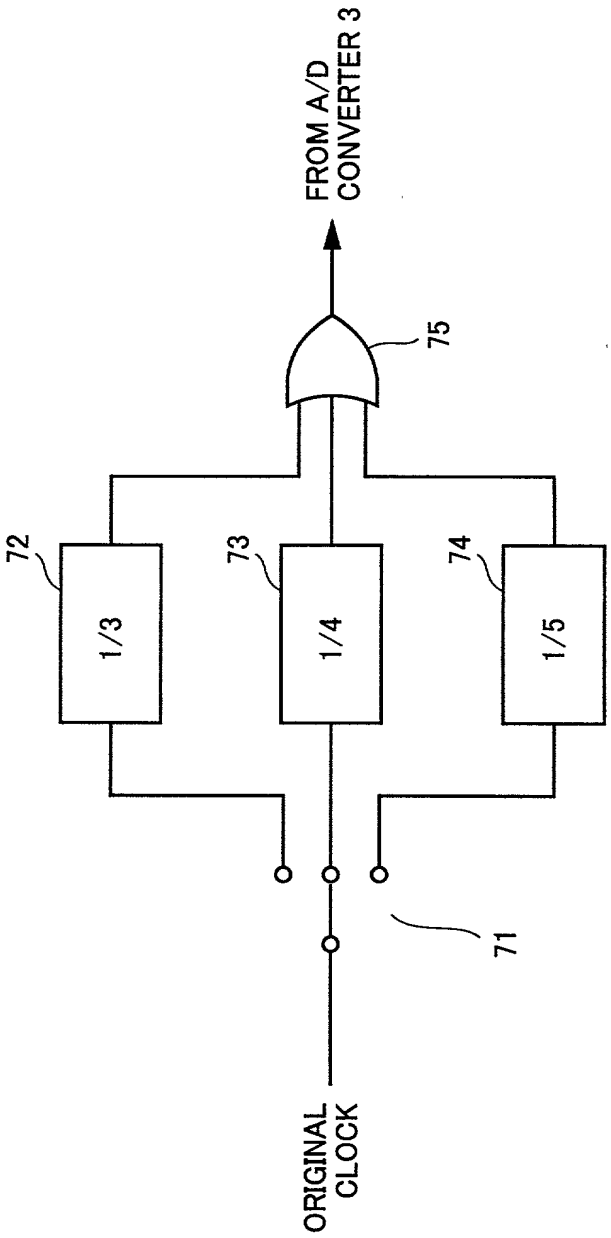


FIG. 3

FIG. 4

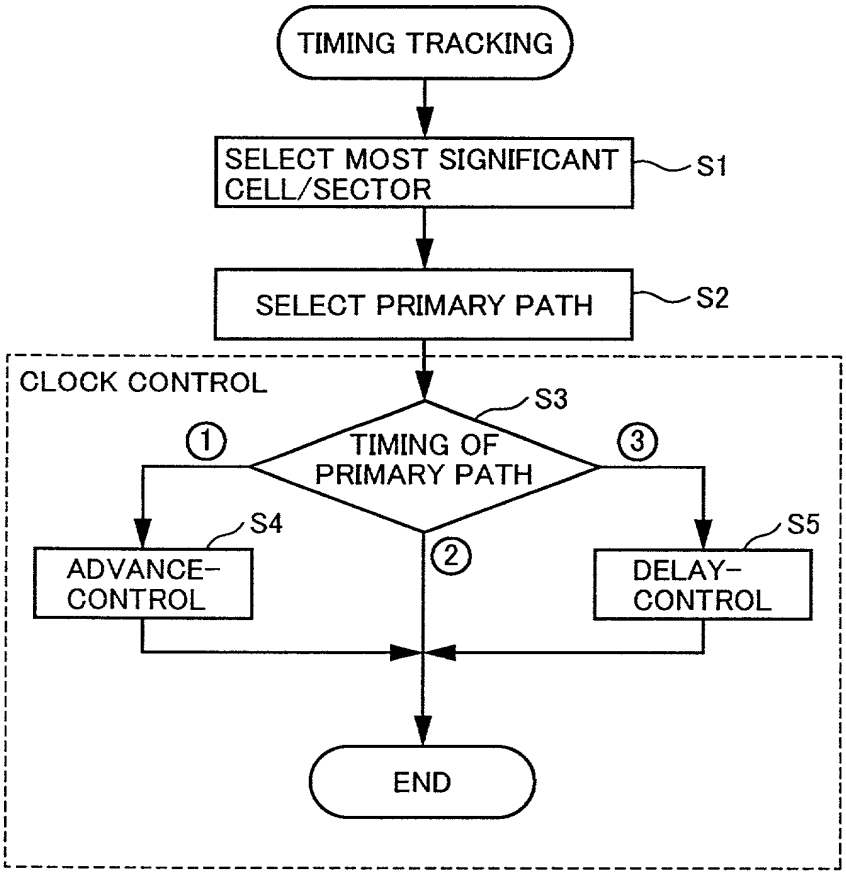

TIMING TRACKING
SELECT MOST SIGNIFICANT CELL/SECTOR
S1
SELECT PRIMARY PATH
S2
CLOCK CONTROL
S3
TIMING OF PRIMARY PATH
①
②
③
S4
ADVANCE-CONTROL
S5
DELAY-CONTROL
END

FIG. 5

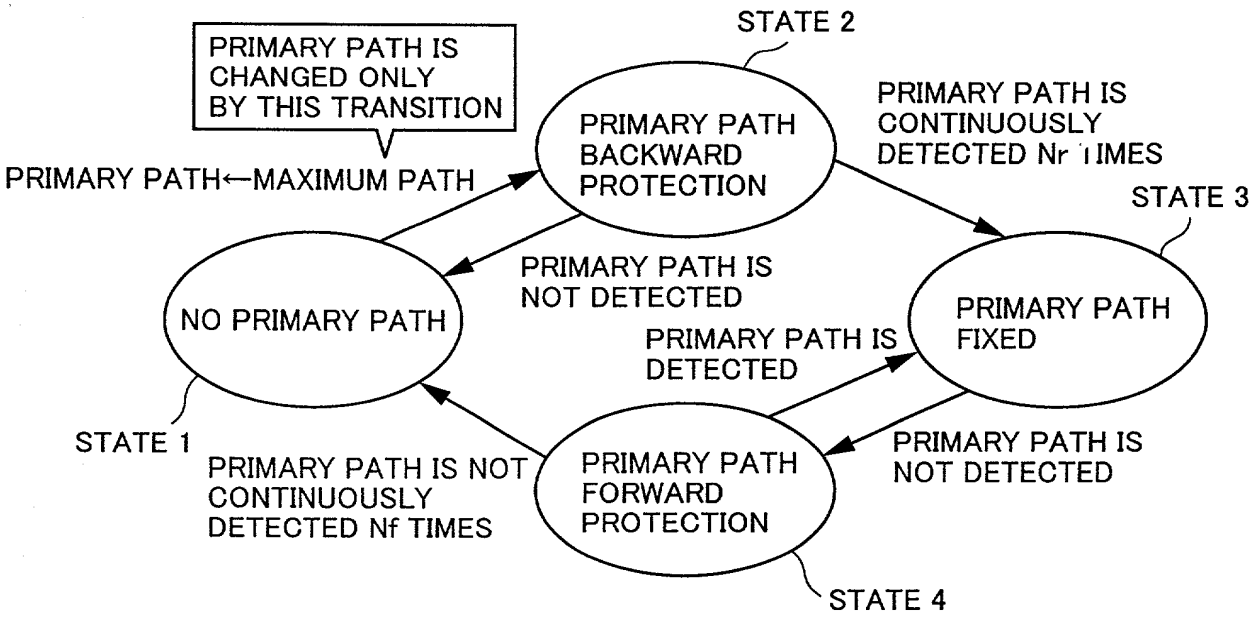

PRIMARY PATH IS CHANGED ONLY BY THIS TRANSITION
PRIMARY PATH←MAXIMUM PATH
STATE 2
PRIMARY PATH BACKWARD PROTECTION
PRIMARY PATH IS CONTINUOUSLY DETECTED Nr TIMES
STATE 3
PRIMARY PATH IS NOT DETECTED
NO PRIMARY PATH
PRIMARY PATH IS DETECTED
PRIMARY PATH FIXED
STATE 1
PRIMARY PATH IS NOT CONTINUOUSLY DETECTED Nf TIMES
PRIMARY PATH FORWARD PROTECTION
PRIMARY PATH IS NOT DETECTED
STATE 4

FIG. 6

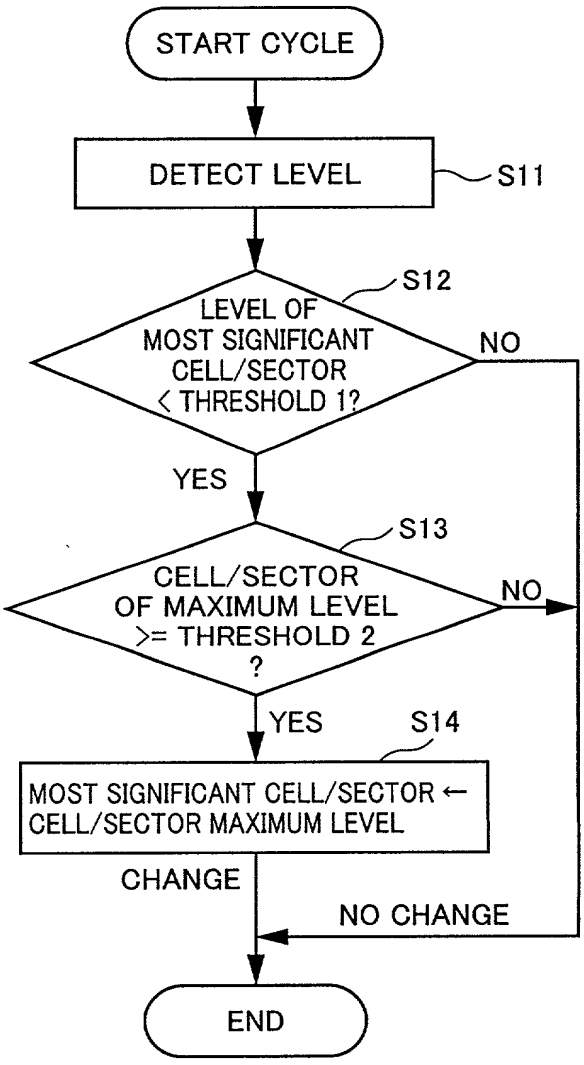

START CYCLE
DETECT LEVEL
S11
S12
LEVEL OF MOST SIGNIFICANT CELL/SECTOR < THRESHOLD 1?
NO
YES
S13
CELL/SECTOR OF MAXIMUM LEVEL >= THRESHOLD 2 ?
NO
YES
S14
MOST SIGNIFICANT CELL/SECTOR ← CELL/SECTOR MAXIMUM LEVEL
CHANGE
NO CHANGE
END

FIG. 7A

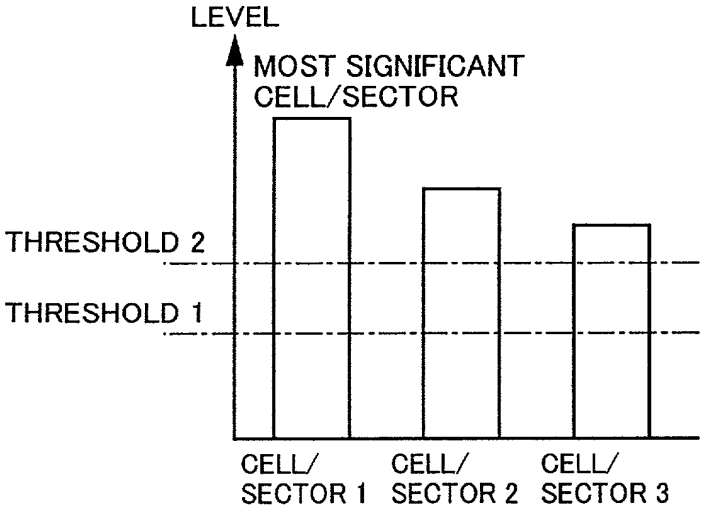


FIG. 7B

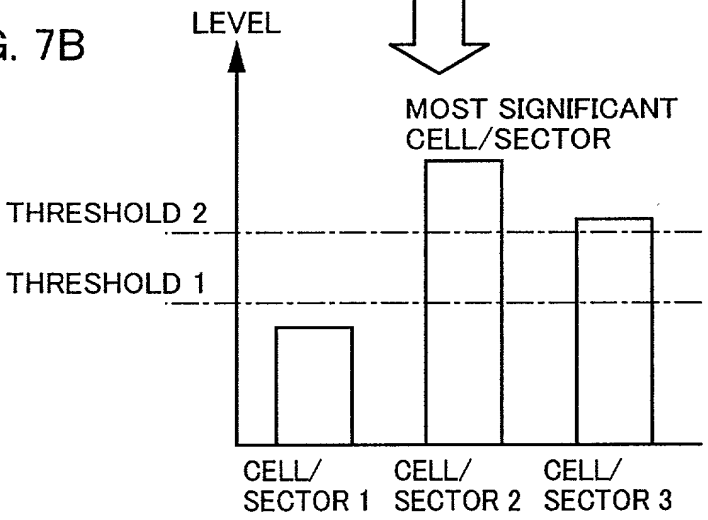


FIG. 8

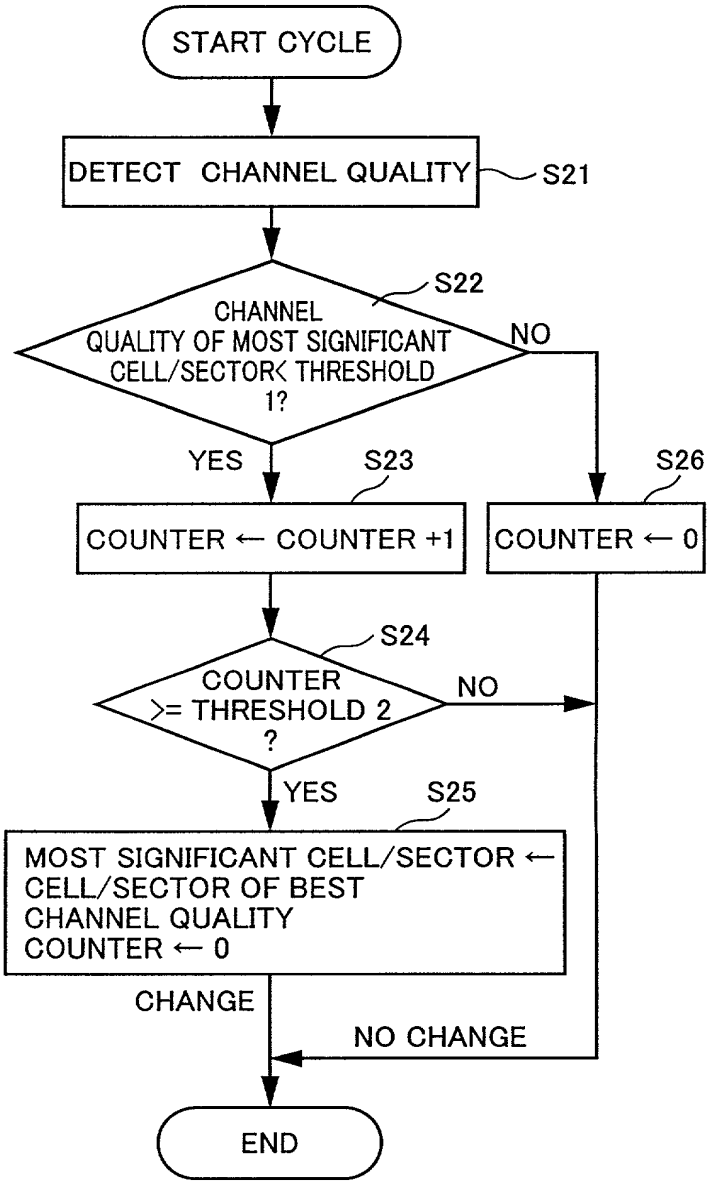
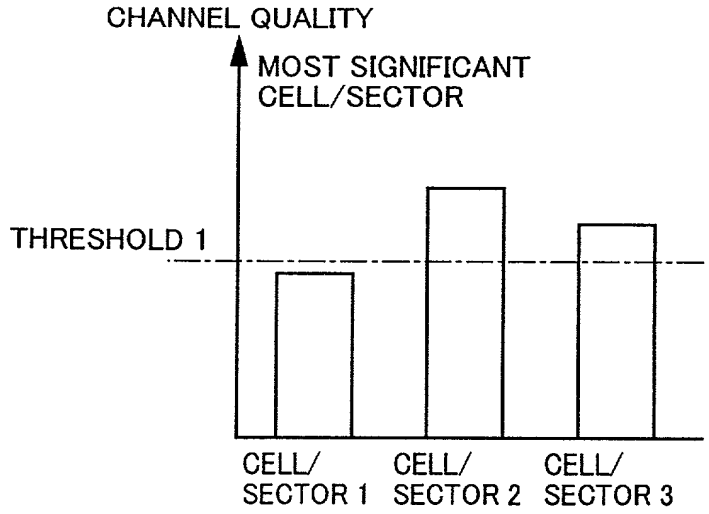

START CYCLE
DETECT CHANNEL QUALITY
S21
S22
CHANNEL QUALITY OF MOST SIGNIFICANT CELL/SECTOR< THRESHOLD 1?
NO
YES
S23
S26
COUNTER ← COUNTER +1
COUNTER ← 0
S24
COUNTER >= THRESHOLD 2 ?
NO
YES
S25
MOST SIGNIFICANT CELL/SECTOR ← CELL/SECTOR OF BEST CHANNEL QUALITY
COUNTER ← 0
CHANGE
NO CHANGE
END

FIG. 9A



CONTINUES (THRESHOLD 2) TIMES

FIG. 9B

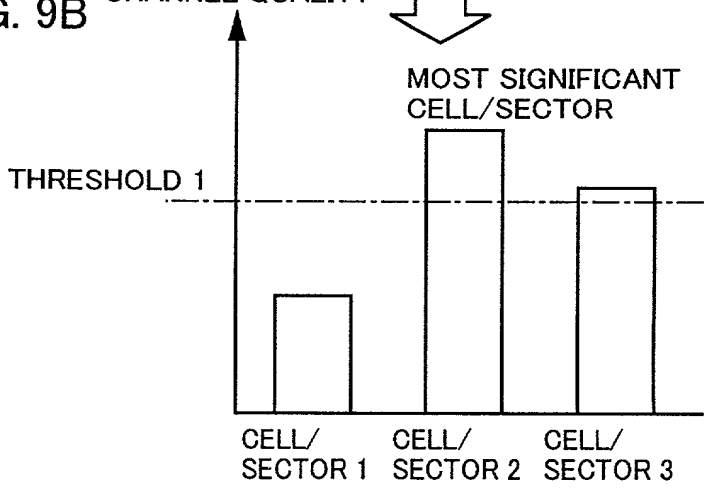


FIG. 10

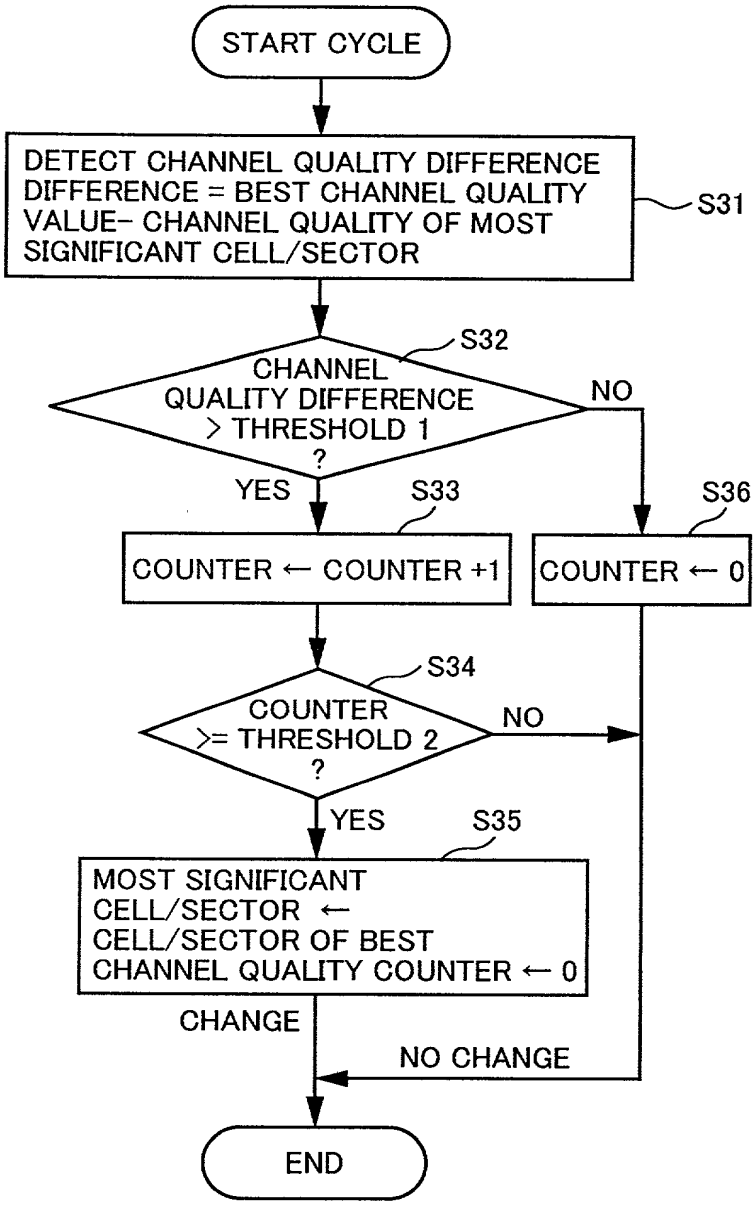

START CYCLE
DETECT CHANNEL QUALITY DIFFERENCE
DIFFERENCE = BEST CHANNEL QUALITY VALUE- CHANNEL QUALITY OF MOST SIGNIFICANT CELL/SECTOR
S31
S32
CHANNEL QUALITY DIFFERENCE > THRESHOLD 1 ?
NO
YES
S33
S36
COUNTER ← COUNTER +1
COUNTER ← 0
S34
COUNTER >= THRESHOLD 2 ?
NO
YES
S35
MOST SIGNIFICANT CELL/SECTOR ← CELL/SECTOR OF BEST CHANNEL QUALITY
COUNTER ← 0
CHANGE
NO CHANGE
END

FIG. 11A

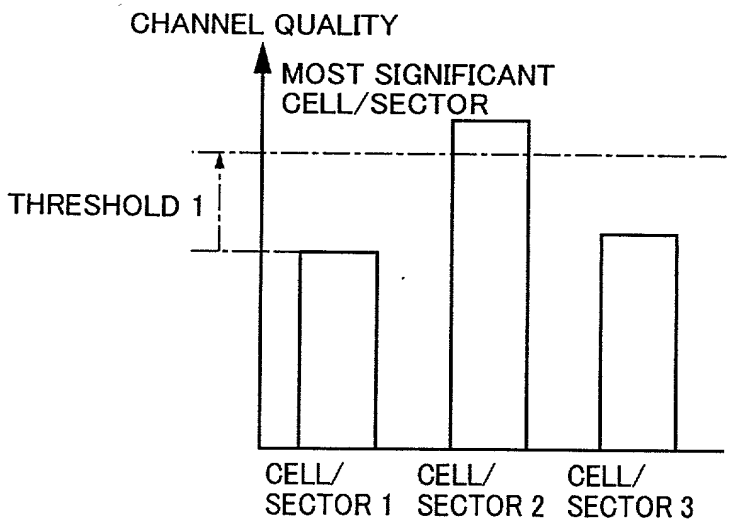


FIG. 11B

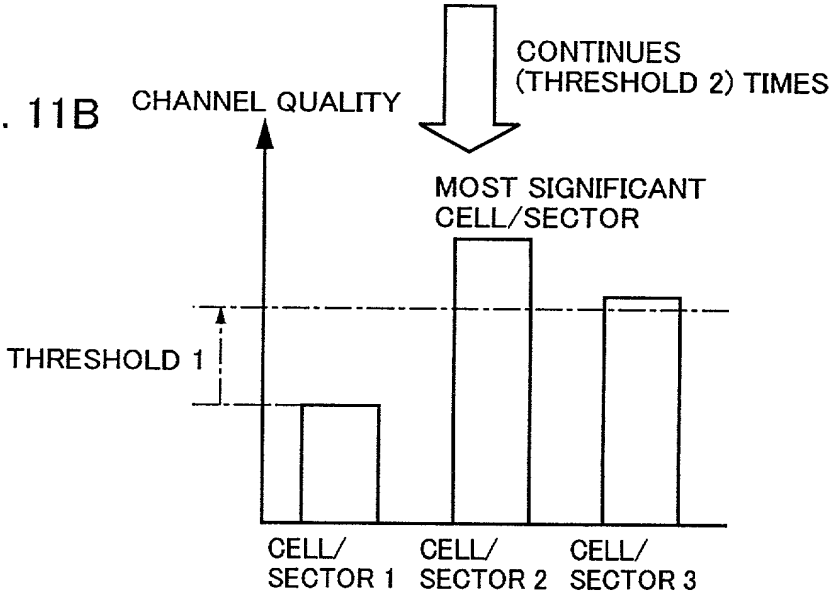


FIG. 12

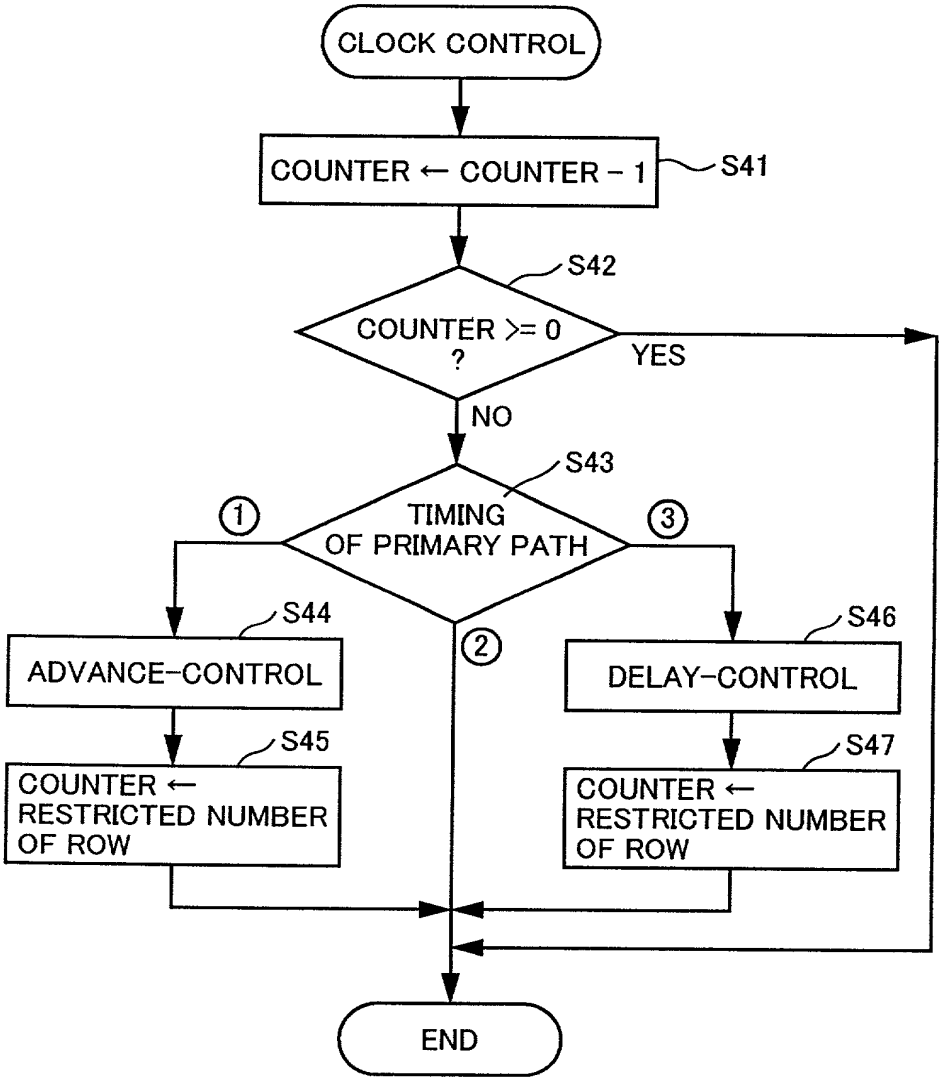
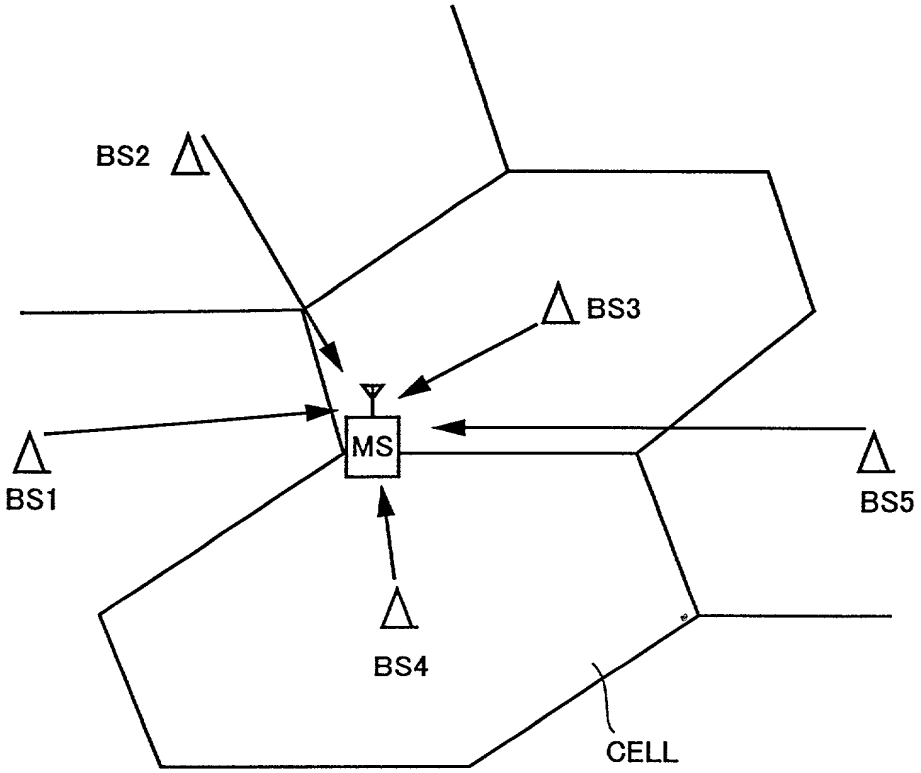

CLOCK CONTROL
COUNTER ← COUNTER – 1
S41
S42
COUNTER >= 0 ?
YES
NO
S43
TIMING OF PRIMARY PATH
①
②
③
S44
ADVANCE-CONTROL
S45
COUNTER ← RESTRICTED NUMBER OF ROW
S46
DELAY-CONTROL
S47
COUNTER ← RESTRICTED NUMBER OF ROW
END

FIG. 13 PRIOR ART



Declaration and Power of Attorney For Patent Application

特許出願宣言書

Japanese Language Declaration

私は、下欄に氏名を記載した発明者として、以下のとおり宣言する：

As a below named inventor, I hereby declare that:

私の住所、郵便の宛先および国籍は、下欄に氏名に続いて記載したとおりであり、

My residence, post office address and citizenship are as stated below next to my name,

名称の発明に関し、請求の範囲に記載した特許を求める主題の本来の、最初にして唯一の発明者である（一人の氏名のみが下欄に記載されている場合）か、もしくは本来の、最初にして共同の発明者である（複数の氏名が下欄に記載されている場合）と信じ、

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

MOBILE COMMUNICATION TERMINAL

その明細書を
(該当する方に印を付す)

the specification of which
(check one)

☐ ここに添付する。

☐ is attached hereto.

☐ _____ 日に出願番号

第 _____ 号として提出し、

_____ 日に補正した。
(該当する場合)

☒ was filed on September 12, 2001 as
Application Serial No. _____
and was amended on _____.
(if applicable)

私は、前記のとおり補正した請求の範囲を含む前記明細書の内容を検討し、理解したことを陳述する。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37部第1章第56条（a）項に従い、本願の審査に所要の情報を開示すべき義務を有することを認める。

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

Japanese Language Declaration

私は、合衆国法典第35部第119 条にもとづく下記の外国特許出願または発明者証出願の外国優先権利益を主張し、さらに優先権の主張に係わる基礎出願の出願日前の出願日を有する外国特許出願または発明者証出願を以下に明記する：

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior foreign applications
先の外国出願

(Number) (番　号)	(Country) (国　名)	(Day/Month/Year Filed) (出願の年月日)	Priority claimed 優先権の主張 ☐ Yes あり	☐ No なし
(Number) (番　号)	(Country) (国　名)	(Day/Month/Year Filed) (出願の年月日)	☐ Yes あり	☐ No なし
(Number) (番　号)	(Country) (国　名)	(Day/Month/Year Filed) (出願の年月日)	☐ Yes あり	☐ No なし

私は、合衆国法典第35部第120 条にもとづく下記の合衆国特許出願の利益を主張し、本願の請求の範囲各項に記載の主題が合衆国法典第35部第112 条第１項に規定の態様で先の合衆国出願に開示されていない限度において、先の出願の出願日と本願の国内出願日またはＰＣＴ国際出願日の間に公表された連邦規則法典第37部第１章第56条（ａ）項に記載の所要の情報を開示すべき義務を有することを認める：

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.) (出願番号)	(Filing Date) (出願日)	(現　況) (特許済み、係属中、放棄済み)	(Status) (patented, pending, abandoned)
(Application Serial No.) (出願番号)	(Filing Date) (出願日)	(現　況) (特許済み、係属中、放棄済み)	(Status) (patented, pending, abandoned)

私は、ここに自己の知識にもとづいて行った陳述がすべて真実であり、自己の有する情報および信ずるところに従って行った陳述が真実であると信じ、さらに故意に虚偽の陳述等を行った場合、合衆国法典第18部第1001条により、罰金もしくは禁錮に処せられるか、またはこれらの刑が併科され、またかかる故意による虚偽の陳述が本願ないし本願に対して付与される特許の有効性を損うことがあることを認識して、以上の陳述を行ったことを宣言する。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration

委任状：私は、下記発明者として、以下の代理人をここに選任し、本願の手続を遂行すること並びにこれに関する一切の行為を特許商標庁に対して行うことを委任する、
（代理人氏名および登録番号を明記のこと）

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (*list name and registration number*)

16

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第２の共同発明者の氏名（該当する場合）	Full name of second joint inventor, if any
同第２発明者の署名　日付	Second inventor's signature　Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

（第六またはそれ以降の共同発明者に対しても同様な情報および署名を提供すること。）

(Supply similar information and signature for third and subsequent joint inventors.)